Outline of Agriculture in Hokuriku District and Research at the Hokuriku Agricultural Experiment Station

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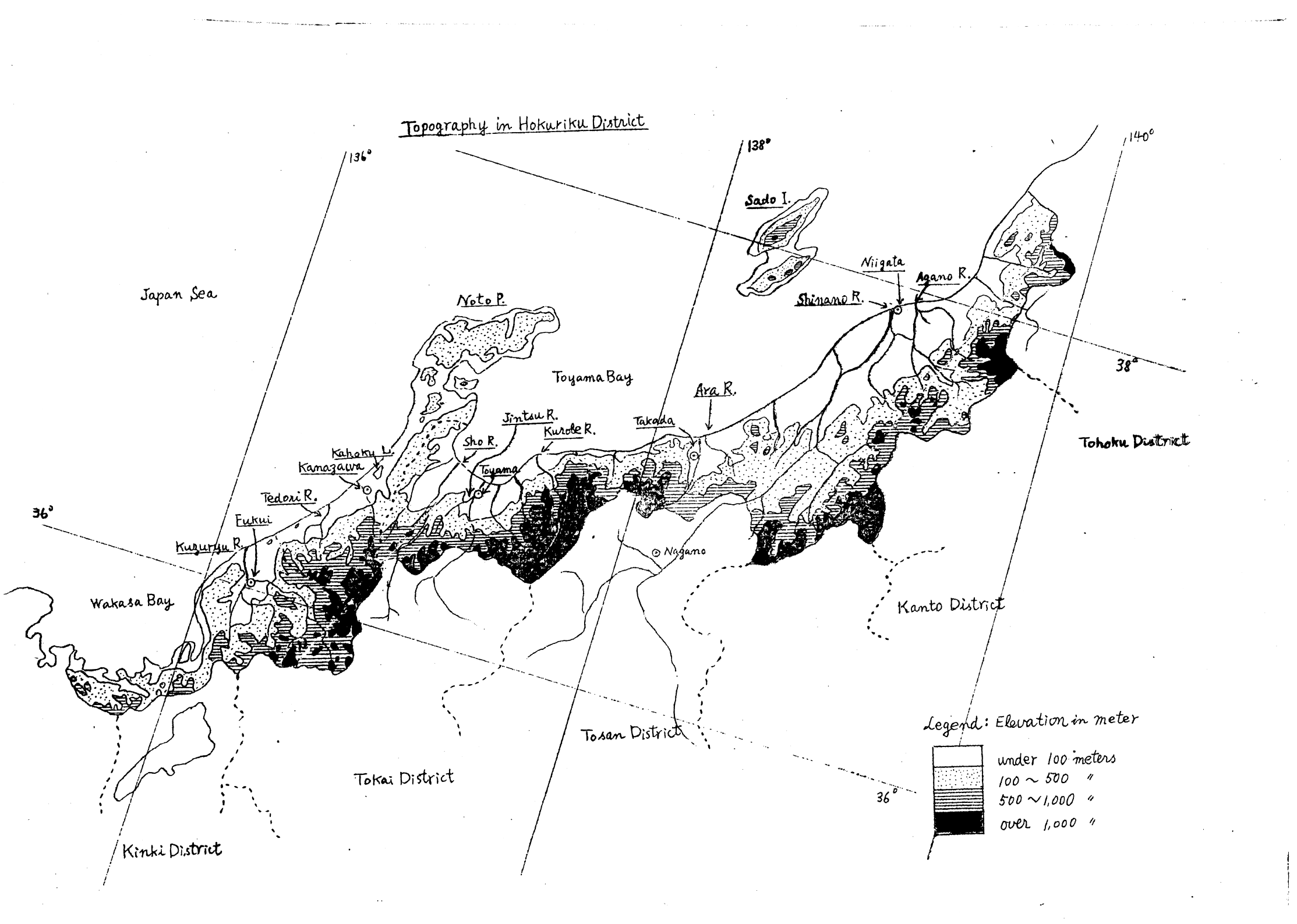
Hokuriku Agricultural Experiment Station
Ministry of Agriculture and Forestry
Government of Japan


Topography in Hokuriku District
136°
138°
140°
Sado I.
Niigata
Agano R.
Shinano R.
Japan Sea
Noto P.
Toyama Bay
38°
Ara R.
Jintsu R.
Kurobe R.
Takada
Sho R.
Kahaku L.
Kanazawa
Toyama
Tohoku District
Tedori R.
36°
Fukui
Kuzuryu R.
Nagano
Wakasa Bay
Kanto District
Tosan District
Tokai District
Kinki District
Legend: Elevation in meter
under 100 meters
100 ~ 500 "
500 ~ 1,000 "
over 1,000 "

Outline of Agriculture in Hokuriku District

1. Geographical Position and Topography

Hokuriku District is located in the Japan Sea side of the central part of the main island of Japan, extending from Long. 135°30′ to 140°E and from Lat. 35°30′ to 38°30′N. There are four prefectures in the District, Niigata, Toyama, Ishikawa and Fukui covering approximately 2,525,100 hectares which constitute about 6.8 percent of the total land area of Japan.

This District is separated from other districts by several mountain ranges and hills streching generally in a northeast-southwest direction. In the northern part the Echigo and the Mikuni Mountain Ranges border Tohoku District. In the southern part the Hida Mountain Ranges, the so-called North Japan Alps embracing mountains higher than 3,000 metres border Tokai and Kanto-tosan Districts and in the south western part the Hakusan Volcanoes border Kinki District.

Several rivers, Shinano, Agano, Kurobe, Jintsu, Sho, Tedori, Kuzuryu, etc. rise in those mountain-ranges and pour themselves into the Japan Sea.

The cultivated land in the District is mostly found in the plains which are formed in wide alluvial cones and on the lower reaches of rivers facing the Japan Sea. In general, all river-beds are raised.

The largest plain is the Echigo Plain formed by the Shinano River which is the longest in Japan and by the River Agano. There is an open, low and moist delta downstream, forming extremely moist paddy fields. Drainage is a very important segment of agriculture and is continuously being carried out. Across the Higashi-kubiki Hills in the south direction Takada Plain extends in the basin of the Ara River. Farther across the Nishikubiki Hills and the northern edge of the Hida Mountain Ranges lies the Toyama Plain, which is different from the Echigo Plain and is an alluvial fan with fairly steep slope at the back.

The Kaga Plain is an alluvial fan formed by the Tedori River. Fukui Plain is found in the basins of the River Kuzuryu and Hino and other adjoinning small rivers. And the Plain is low and moist, very similar to the Echigo Plain.

A line linking Itoigawa of Niigata Prefecture with Shimuoka is a structural zone traversing central Honshu, which is known as the Fossa Magna.

The coast line of the District runs generally from north-east to south-west, practically straight in the upper part but irregular in the lower part with Noto Peninsula salient far out to sea, forming Toyama and Wakasa Bays.

In parallel to the coast line, belt-like dunes are found. Practically all the plains are used as paddy fields and very small part of them, intermountainous areas and a part of coast dunes are used as upland fields.

II. Climate

The climate of Hokuriku District is same as that of other districts, mild and humid and is influenced by monsoon. That is, temperature, precipitation and sunshine hours for the summer crop from May to October are extremely favorable for rice cultivation. And because of that about 84 % of the total cultivated land is devoted to paddy rice cultivation.

On the other hand, the climate during the winter crop from November to April is characterized by a remarkably heavy snowfall and extremely short sunshine hours because dry monsoon from Siberia absorbs moistures from the Tsushima Warm Current and hits frequently mountain ranges forming water-shed in Honshu. In other words, whereas the heaviest precipitation in other parts of Japan occurs in June-July or September-October while the same occurs in December in this District.

Snow-fall in the District is the heaviest in Japan. It reaches over 200 cm in the mountainous areas and 70 to 80 cm even in the plains. Takada has so far continuously marked the highest record exceeding 200 cm on an average. The period of continuous snow-cover in the District is in general somewhat shorter than that of the Tohoku District. However, it extends 60 to 80 days in coastal areas, 100 to 120 days in the plains and over 140 days in the mountainous areas.

Excessive precipitation and too long and continuous snow-cover are the factors which prevent the increase in the utilization rate of

cultivated land, especially of paddy field. The utilization rate of paddy field for double cropping during the winter season in the District is only 10 %, being less than a half of the national average.

Such weather conditions as excessive moisture and extremely short sunshine hours restrict the kinds of crops for cultivation and 90 % of total planted acreage used for second-crop is devoted to the culture of Renge (Astragalus sinicus L.)

In addition, phenomenon called Fohn blowing down from the mountain ranges in late spring to summer is a dry wind salient in the District. The wind causes a sudden rise in temperature.

III. Geology and Soil.

As stated above, high and steep mountain ranges divide the District from other districts.

The geology of these mountainous areas is Chichibu palaeozoic strata, palaeozoic granites, Hida metamorphic rocks, granodiorite, jurassic strata and others. Tertiary strata is widely distributed in most of the hills. Rocks of the tertiary strata are shale, mudstone, sandstone, conglomerate and igneous rock. Adjoining the tertiary strata there is the diluvium, generally forming table-land. Diluvial table-lands are mostly used as upland field. Alluvial strata are distributed in fans or delta formed by deposition of soil and sand by rivers. Upland fields are distributed in coastal dunes and naturally formed banks of alluvial strata beside diluvial table-lands, tertiary hills and gently-sloping hillsides of volcanoes. Considerable differences in soil properties are found in upland fields according to the variation in geological derivation and parent materials. Upland soil in diluvial table-lands and tertiary hills are acidic in most cases. However, calcareous mudstone soil of tertiary strata shows alkali reaction, though its distribution is small. Parent rocks of soils from volcanic ashes are mostly augite andesite, double-augite andesite, etc. with soil surfaces being rich in humus in general. Most of the clays in these soils are allophane. Such volcanic ash soils were formed by deposition of volcanic ashes erupted from the end of Tertiary period to Quarternary period. In these soils bases eluviate to a great extent, and soils are acidic with

strong phosphoric acid absorbing capacity. In broad sense soils of coastal dunes belong to Lithosols and the development of soil profile is not found. Moreover, content of clay and silt is small and absorbing and holding capacities of nutrition and water are very weak.

Paddy fields in most cases spread in fan and delta. Those in fan are low in ground water table and are good in drainage because of sandy loam or loam.

In the end of fan, however, paddy fields are ill drained because of springing water. Paddy fields in delta are low above the sea level and are consequently high in ground water table. And most of paddy fields are poor in drainage because of clay or clay loam soil. As much as 60 % of total paddy fields or 220,000 ha of the District is ill drained.

Nearly all soils of ill drained paddy fields have gley horizon. In low land surrounded by lagoons and in valleys soils with peat or muck horizon are often found. Black volcanic ash soil is distributed in low land along the borders of table land although the acreage thereof is small. And such ill drained paddy fields are all rich in soil fertility, yet are disadvantageous to carry out the intensive utilization and to increase the productivity. To drain such paddy field large scale drainage projects are being carried out with the Government investment.

IV. Land Use

Approximately 412,000 ha constituting 17 % of the total land area of the District is used for crop cultivation with very small acreage for grazing and mowing. And over 87 % of the total cultivated land or about 353,000 ha are paddy field.

Rice is by far the most important crop in Japan. And greater part of farm land in Japan is used as paddy field. The same is true in Hokuriku District, particularly because of 1/ flat plain; 2/ abundant water from heavy snow and 3/ favorable climate for rice cultivation.

Upland fields are scattered in coastal dunes and in high place of flat plain and along slopes of the bases of steep mountains. Such upland fields would have been converted into paddy field if cheaper water is available.

As far as the economic state in Japan up to now is concerned, no profitable agriculture other than rice culture has so far existed in this District. By the consecutive efforts having been done since the ends of the Meiji Era (about 1910), 115,433 ha of paddy fields or 32.6 % of the total were improved to be able to make double cropping and in part of those forage crops for dairy farming are grown. Vegetables are grown in the suburbs of cities as cash crops and in dunes and at bases of mountains fruit trees are grown. Besides, other crops such as mulberry, tea and flower bulbs, and such a special crop as scallion are grown but are not important farm products of the District.

V. Size of Farming.

There are 452,958 farm households in the District cultivating 421,819 ha. That is, average holding per farm household is less than 1 ha. To make a living mainly by the income obtained from rice production an average of 2 ha of paddy field is needed. And only 7 % of the farmers in the District have a holding of over 2 ha of paddy field. The others are part-time farmers working in forestry, fisheries, hired labor and small shop, etc. The percentage of part-time farmers of the District is very high compared with the national average, reaching as high as 80 % in Fukui and Ishikawa Prefectures. The increasing tendency in part-time farmer is a phenomenon salient in Japan in recent years. Many families are divided into a group to carry on agriculture and other in non-agriculture work. Such status on labor front of the District creates a difficulty in rice culture which requires so much hand labor during transplanting and harvesting time.

VI. Livestock.

Few domestic animals have been kept by farmers in the District compared with other districts. Present livestock production unit per farm household is 0.38 while that for the nation is 0.66. Not only dairy and meat cattles are few but there are not enough draft animals. Reasons for that are because the Buddhism prohibiting the eating of meat was very popular in the District, while marine foods were abundant, and draft animals could be borrowed in low rent from neighboring districts after the use of draft animals became popular.

In this District dairy cows were firstly introduced in the suburbs of

Kanazawa and Komatsu cities in Ishikawa Prefecture around 1910 and afterwards in the west of Toyama and Fukui Prefectures.

Number of domestic animals increased sharply in the last 10 years. At present there are 20,000 dairy cows, 110,000 meat cattles, 80,000 hogs, 34,000 goats and sheeps respectively and over 2 million hens.

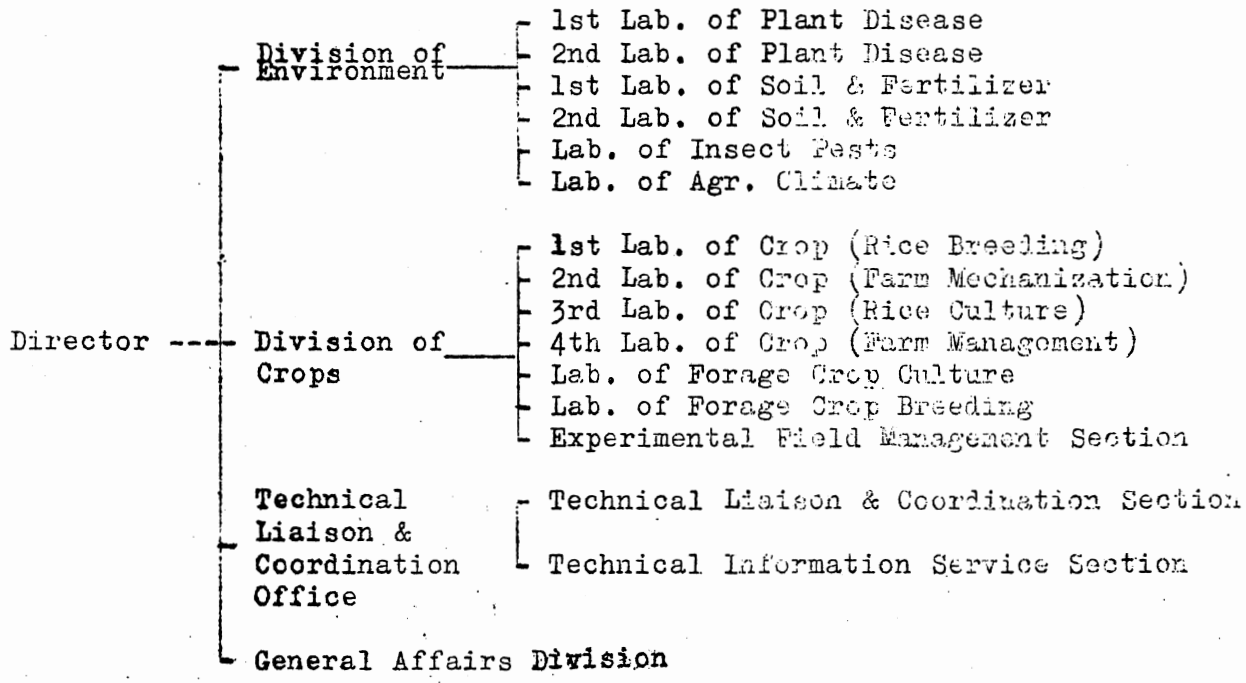
VII. Farm mechanization.

As sufficient number of draft animals has not been raised in the district, power tiller was used from earlier time. The order in which machinery was introduced in agriculture in Japan was firstly pump, secondly machinery for threshing, hulling, winnowing, separating, thirdly power-driven tiller and lastly machinery for disease and insect control. However, in this District, machinery for threshing, hulling, winnowing, separating, etc. were first introduced and were followed by power-driven tiller. The reason for that is because threshing, hulling, and packing had to be finished in an extremely short period to expedite the marketing of rice in between-season. The ratio of the number of tiller to the cultivated land is as shown in Table 7. There are about 20 large tractors in the District. But, as those tractors were introduced for experimental purpose they are not operated on economic basis. However, because of the increasing farm labor shortage farm mechanization with the introduction of larger tractor is one of the urgent necessity for the District together with the time saving cultivation technique and cooperative drying facilities which number 18 in the District, but more or less in the experimental stage.

Organization and Object of the Hokuriku Agricultural Experiment Station

The Hokuriku Agricultural Experiment Station is one of the eight Regional Agricultural Experiment Stations established throughout the country by the Ministry of Agriculture and Forestry, to carry out the agricultural experiment and research for the Hokuriku District covering four prefectures of Niigata, Toyama, Ishikawa and Fukui as well as for other regions with similar conditions.

The Station consists of 3 divisions and 1 office as shown below.



The Division of Crops carries out the experiment and research on breeding and culture of paddy rice and forage crops. The Division of Environment carries out the experiment and research on soil and fertilizer, ecology and control of insect pests and disease and agricultural climate.

The Technical Liaison and Coordination Office takes charge of liaison and coordination of experiment and research being conducted at the research organs within the District, the investigation of agricultural management and the collection of publications and documents.

The research at the Station aims at further developing paddy rice agriculture based upon the peculiality of various natural and socio-economic conditions of this District, thus contributing to the welfare of farmers in the District. Therefore, the Station conducts researches on the stabilization and increase of paddy rice production as the main subject and at the same time researches on the rationalization of agricultural management by the intensive land utilization and the introduction of dairy farming.

Personnel

Post	
Director	1
Chief of Division	3
Technical Liaison & Coordination Office	1
Chief of Section	2
Chief of Laboratory	11
Subsection Chief	6
Researcher	51
Clerk	9
Technical Official	20
Technical Assistant	27
Laborer	4
Total	135

Land and Buildings

1. Land

Item	Experimental Farm			Buildings' Sites	Waste Land	Water Channel & Road	Others	Total
	Paddy Field (m^2)	Upland Field (m^2)	Total (m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
Inada, Head Quarter	60,192	7,178	67,370	25,529	---	20,519	1,040	134,457
Motoshiro, Upland Experimental Farm	---	15,345	15,345	1,650	28,346	7,570	---	52,909
Meiji, Paddy Experimental Farm	49,952	---	49,952	9,537	---	2,663	---	62,152
Total	100,144	22,523	132,667	36,716	28,346	30,752	1,040	229,518

2. Buildings

Item	General Affairs (m^2)	Researches (m^2)	Managing Experimental Farm (m^2)	Official Residence (m^2)	Total (m^2)
Inada, Head Quarter	1,112	3,600	861	1,462	7,035
Motoshiro, Upland Experimental Farm	--	584	182	109	875
Meiji, Paddy Experimental Farm	26	--	545	43	614
Total	1,138	4,184	1,588	1,614	8,524

Brief History of the Station

April, 1944 : The former Joetsu Branch of Niigata Prefectural Agricultural Experiment Station was transferred from Niigata Prefecture to the Ministry of Agriculture and Forestry as the Hokuriku Branch of the National Agricultural Experiment Station of the same Ministry.

April, 1950 : The Station became independent as the Hokuriku Agricultural Experiment Station consisting of the Agronomy Division with 7 Laboratories and General Affairs Section.

May, 1951 : With the absorption of Nagaoka, Yamagata and Asaka Agricultural Improvement Experiment Stations, the Station's organization was changed and became 2 Divisions (Division of Crops with 6 Laboratories and Division of Environment with 5 Laboratories) and 1 Section.

April, 1952 : The Laboratory of Plant Diseases was divided into two laboratories of the First and the Second.

July, 1956 : The two-story ferro-concrete main building was newly established.

May, 1957 : The Technical Liaison and Coordination Office was established to have closer liaison with other national and prefectural agricultural experiment stations and also to collect and examine various information and data.

April, 1960 : The Agricultural Climate Laboratory was established.

April, 1963 : The General Affairs Section was reformed to the Division of General Affairs. The research subject of the 2nd Crop Lab. was changed. The 1st Crop Lab. became Rice Breeding Center covering Tohoku and Hokuriku.

Outline of the Experiment and Research

1. Technical Liaison and Coordination Office

(1) Technical Liaison and Coordination Section

To meet the needs in compliance with the change in agricultural policy of Japan, this Section takes charge of a new business on agricultural structural improvement in addition to business already being assigned.

(i) Agricultural structure improvement pilot area.

In 1962, two areas to each prefecture, 8 areas as the total for the Hokuriku District were designated as the pilot areas. The Section is to examine the type of the agricultural structure to be introduced into the District in future and to investigate the process therefor.

(ii) Investigation and planning on the experimental farm for agricultural mechanization.

To promote the agricultural mechanization as an integral part of the agriculture modernization an experimental farm for introducing a large tractor was established in Ishikawa Prefecture under the direction of the Ministry of Agriculture and Forestry. The Station cooperates with Ishikawa Prefecture by sending personnel to investigate and exchange views.

(iii) Farming-type experiment on farmer's own field.

The farming-type experiment is now being carried out throughout the country to improve farming-type in farmer's own field.

In 1962 two places were designated in the District as the farming-type experiment plots. The farming-type experiment was made at Ishikawa County, Ishikawa Prefecture to test on whether or not the dairy farming by an individual management can be profitable. And at Sado County, Niigata Prefecture the possibility of cooperative dairy farming was tested. The Station cooperates with Ishikawa and Niigata Prefectural Agricultural Experiment Stations by exchanging views and data.

(iv) Others.

The following functions are also in charge :

Coordination and liaison with the Ministry of Agriculture and Forestry

as well as with each prefecture in the District concerning technical matters and problems in common on the experiment and research.

(2) Technical Information Service Section.

(i) Publication of the results of experiment and research.

Publications already completed are :

News on Research : No. 1, 2.

Hokuriku Agricultural Research : Vol. 1, No. 1, 2.
Vol. 2, No. 1, 2.
Vol. 3, No. 1, 2.

The Bulletin of Hokuriku Agricultural Experiment Station :
No. 1, 2, 3 and 4.

Investigation Data : No. 1, 2.

Summary of the Annual Conference on Agricultural Experiment and Research in Hokuriku District : Every Year from 1955.

(ii) Collection and Arrangement of Books and Data.

As the classification and arrangement of books and data were nearly completed it is planned to collect more books and data for the research. In addition to the above, the Office acts as a secretariat of the Extension Worker Conference in the Hokuriku District and gives advices to various training courses held for agricultural extension workers.

2. Division of Crops.

First Laboratory of Crop.

Research Subjects : Breeding of new paddy rice varieties.

Present Research Situation : The goal of breeding works assigned to the Laboratory is to breed the superior varieties of paddy rice adaptable for mainly 4 prefectures in Hokuriku District, as well as for the areas along the Japan Sea. At present, chief aim of selection has been concentrated to variety of high yielding, good quality, strong culm and disease resistance.

At present, about 2.3 ha are used as experimental farm by this Laboratory consisting 7 researchers. It is expected to expand the experimental farm.

1. The breeding works are being conducted as follows.

(1) Experiments for breeding varieties by pedigree method.

i) Crossing ; 21 combinations.

ii) F1 ; 52 combinations ; 1,300 individuals.

iii) F2 selection of individuals ; 37 combinations ; 195,900 individuals.

iv) F3 selection of lines and individuals; 30 combinations; 1,464 lines.

v) Post-F4 lines selection; 77 combinations; 211 pedigree groups.

vi) Experiment on productivity of inbred lines.

vii) Experiment on characters of inbred lines.

(2) Experiments for breeding varieties by bulk method.

i) Cultural practice of post-F2 bulk population.

ii) Selection of individuals from bulk population.

iii) Experiment of productivity of inbred lines.

(3) Adaptability experiment of lines.

2. Fundamental researches for breeding new varieties.

To establish new breeding mthod, in parallel with the breeding works, researches on culture practice method of bulk population and method of character testing are being carried out.

Main Results.

Shirogane, registered with the Ministry of Agriculture and Forestry as Norin No. 81.

Sekiminori as Norin No. 92.

Azusa " No. 97.

Akiminori " No.109.

Tarehonami " No.110.

Yomohikari " No.111.

2nd Laboratory of Crop

Research Subjects : To establish mechnized rice cultivation.

Present Research Situation :

The research subject of the Laboratory untill last year was the breeding of new wheat and barley varieties. However, from this year the same has been changed to mechanization of rice cultivation, especially of threshing and drying because of heavy rainfall during harvest time and wide distribution of ill drained paddy field in the District.

Some preliminary experiments are now being conducted.

The themes to be taken after next year are as follows :

1. Research on mechanization of threshing and drying works under heavy rainfall in autumn.
   1 To find a proper time for mechanical threshing;
   2 Method of drying rice hills in standing;
   3 Threshing and hulling;
   4 Drying hulled grains.
2. Research on mechanization of plowing, fertilizing and sowing.
   1. Sowing method in direct sowing cultivation method;
   2 Mechanization in rice cultivation in ill drained paddy field.

3rd Laboratory of Crop.

Research Subjects : To improve the method of rice culture in Hokuriku the following researches are being conducted.

1. Weed control;
2. Developmental physiology concerning high yielding capability;
3. Improvement of direct-sowing-cultivation method;
4. Developmental physiology of rice plant in deep plowed paddy field;
5. Movable control of rice plant growth by chemical treatment.

Present Research Situation : Subjects such as rearing of strong seedling, early seasonal cultivation and irrigation and drainage control have been examined as part of the common nation-wide problems. However, research subjects are being changed to meet the need caused by various socio-economic changes such as accelerating shortage in farm labor, change in national diet habit, stability in food supply, introduction of diversified farming in compliance with the agricultural structure improvement program. Accordingly, the Laboratory concentrates on the establishment of labor saving rice cultivation techniques such as 1/ improvement of direct sowing cultivation method in Hokuriku, 2/ rice cultivation method in deep-plowed field, 3/ effective weed control and 4/ efficient harvesting and drying.

Main Results.

1. Early seasonal rice cultivation method in Hokuriku was completed.
2. Irrigation and drainage control in ill drained paddy field was studied.

4th Laboratory of Crop.

Research Subjects.

1. Improvement of agriculture concentrating on rice culture by the introduction of dairy farming in heavy snow area;
2 Agricultural mechanization in Hokuriku District.

Present Research Situation.

The Laboratory conducts the following researches from the standpoint of farm management.

1 Collection and arrangement of various data on the rice culture combined with livestock rearing and on-the-spot survey thereof especially, concentrating on the same program in Niigata Prefecture starting from 1962;
2 Farm mechanization system with large machinery and collection and analysis of statistical data on the farm mechanization in Hokuriku District;
3 In addition, various surveys in connection with the agricultural structure improvement program in cooperation with Technical Liaison and Coordination Office.

Main Results.

1 Factors which prevented the introduction of second crop into paddy field in the District were clarified (in 1953).
2 Contributing of the breeding of new paddy rice variety, 'Norin No.1' to increase in productivity in the District was clarified (1954-55).
3 Trends of paddy rice varieties grown in Hokuriku District and relationship between development of agricultural production and variety improvement were investigated (1954-55).
4 It has been found that increased rice productivity in the Kambara Plain is achieved not only by land improvement but in a chain relation with improved cultivation techniques and development in farm mechanization (1956-57).
5 Planning of farming types, by regions (1961):

The Agricultural Basic Law enacted in Japan in 1961 codifies as one of the purposes to promote the selective

expansion with sound farm management. Attempt has been made in cooperation with each agricultural experiment station of the District to establish a type of farm management fitting to particular area;

(i) Concentrating on rice culture in Niigata flat paddy area;

(ii) Concentrating on rice culture in Niigata intermountainous paddy area;

(iii) Concentrating on rice culture in Tonami flat paddy area;

(iv) Concentrating on dairy farming in Kaga flat paddy area;

(v) Concentrating on rice culture in Kuzuryu flat paddy area.

Laboratory of Forage Crop Culture.

Research Subjects.

1. Research for the production increase of forage crop in paddy field as winter crop and in upland alternated with paddy field.

(1) Growing period and productivity.

(2) Summer-wilting and winter-killing.

(3) Physiology and ecology.

(4) Weed control.

(5) Sowing method on unprepared field.

2. Collection and character testing of forage crop.

Present Research Situation.

1. Cultivation methods of sorgo, new sorgo and teosinto.

This research is being carried out to solve the fodders shortage in midsummer together with "research on controlling methods of summer-wilting in Ladino clover". Besides, this research aims at clarifying the effects of soil moisture conditions on the seasonal trend in growth and yield of grasses.

2. Control of summer-wilting phenomenon in Ladino clover.

This research aims at clarifying the effect of soil moisture condition and difference in fertilizer application to the seasonal trend in growth and yield of Ladino clover and at the same time aims at establishing the control method of summer-wilting and the method for increasing yield. As a link in the chain of a nation wide survey growth and yield surveys are being conducted in the high productive area of Ladino clover in Ishikawa Prefecture.

3. Growth habit of Ladino clover.

This research is conducted to pursue the growth habit in each growing stage and to find out the condition and power of regrowth after mowing for the improvement of forage culture and for yield increase.

4. Weed control of barley by use of herbicide.

This research is conducted to examine quantity and application time by kinds of herbicides.

5. Sowing method on unprepared field.

In region of snow-cover supply of fodder is in shortage from

late autumn to early spring. And to alleviate the situation sowing method on unplowed and unlevelled field after harvesting of summer crop, especially of paddy rice and on spaces between standing rice hills are being examined from the labor saving viewpoint. Kinds of forage crops tested are Italian ryegrass and oats, and those mixed sowing are also being tested.

6. From the viewpoint of new crop introduction, the growth habit, yield and resistance against snow damage of Russian Comfrey (Symphtum Peregrinum) are being examined.

Main Results.

1. Resistance of rape to wetness was improved.

2. Control method of the sterility in the lower spikelets of barley common in Hokuriku District was investigated and thereby yield increase as high as 20-30 % was obtained by fertilizer application method in the right time.

3. As to the late-seasonal culture of rice, research was made to obtain good yield with the early varieties and to improve seedling rearing method to prevent damage in transplanting. The data have contributed to the development of double cropping and alternative use of paddy field and upland field.

4. Survey was made to clarify the present situation of rice monoculture and factors preventing the introduction of second crop and its possibility of development in Hokuriku. As the result thereof a guiding principle was obtained for the introduction of second crop into paddy field.

Laboratory of Forage Crop Breeding.

Research Subjects.

1 Breeding of new Renge variety resistant to snow damage and coldness.

2 Fundamental research on breeding of Renge plant.

3 Breeding of new root-crop variety for forage of high yield and tolerant for storing.

4 Fundamental research on breeding of root crop for forage.

5 Character testing experiment of the resistance of grass against snow-damage.

6 Research on the culturing method of forage crop in the cool and cold region covered with snow.

Present Research Situation.

1. To stabilize the culture of Renge plant and to promote the use of Renge as forage, breeding of new Renge variety resistant to snow damage and disease is being conducted. In addition to the pedigree method, another breeding method which synthesizes variety by the use of heterothis is used. As a chain in the link of breeding program, the character testing experiment of resistance to snow damage (resistance to pythium snow blight) frequently occurring in the semi-ill drained paddy field or in a case of delayed sowing time, the productivity and adaptability testing experiments are being conducted in cooperation with each prefectural agricultural experiment station.

2. As to the breeding of Renge, clarification of the hereditability of useful characters and interrelation between respective characters are carried out.

3. As to the root crops for forage, the breeding is being conducted to obtain variety of better growth and development, resistant to disease and insect pests as well as tolerant to storing.
In breeding experiments of turnip for forage, beside the varietal crossing, the inter-species hybridization with rutabaga is being practiced and promising lines have already been obtained.

4. For increasing the efficiency of breeding work, the following experiments and researches are being conducted:

(1) Growth habits and ecology of the existing varieties and lines;
(2) Percentage of self and open pollination;
(3) Heterothis;
(4) Efficiency in selection of quantitative characters;
(5) Mechanism of tolerance for storing.

5. The character testing experiment on the recistance of lines of rye grass, orchard grass and other grasses to snow damage is continued.

6. To stabilize the forage crop growth against various obstacles, experiment on culturing method such as the controlling method of Renge Scleratinia rot and use of herbicide are also being conducted.

Main Results.

1. New variety, Renge Hokuriku No. 1.

2. As to the fundamental research, the normination of Renge plant, its history of culture, development of floral organs, flowering, fertilization, development of embryo, hard-coatedness in seed and heredity relation of flower color and flowering date have been clarified. And also the artificial crossing method was established and varietal difference in resistance to snow-damage was investigated.

3. Promising lines of turnip for forage have already been obtained. The growth habits of representative varieties were made clear.

4. Varieties of forage crops suited to this District have been selected and fundamental problem of culturing method of forage crop was pursued for practical purpose. Besides, cooperative experiment was conducted with each prefectural agricultural experiment station within the District to establish the control method of Renge Sclerotinia rot.

Division of Environment.

1st Laboratory of Plant Disease.

Research Subjects.

1. Varietal resistance to rice blast, especially ear blast and its testing method.

2. Varietal resistance to Bacterial leaf blight and its testing method.

3. Disease damage on forage crop.

Object and Present Situation of Research.

Rice culture in future requires labor saving. It is also desirable to stabilize the growth of forage crop to be introduced in farm alternated with paddy field. To meet the requirement the Laboratory is studying the use of disease resistant varieties and the testing method of their resistances which is the basis of breeding techniques. At the same time, the Laboratory is studying the ecology of diseases of forage crops in the Hokuriku District and the control method thereof.

Main Results.

1. Experiment on resistance of varieties against rice ear blast.

Testing method of varietal resistance to rice-leaf blast has progressed by various researches in the past and the results were put into practical use. However, no testing method of varietal resistance to rice ear blast such as neck blast and panicle branch blast has been established. For this reason, it is difficult to breed varieties resistant to ear blast. The Laboratory is now examining the method for testing varietal resistance against ear blast with various testing techniques. So far the Laboratory has found a cultural method of mass sporulation of rice blast fungi necessary for inoculation and obtained some information upon the direct testing of varietal resistance in the heading stage of many varieties.

2. Testing of varietal resistance to Bacterial leaf blight.

With the recommendation and dissemination of early-transplanting and high yielding culture in Hokuriku District, a rapid increase of occurrence of Bacterial leaf blight is common and the disease shows a tendency of wide outbreak. The disease originally occurs in the warm region. So the research on resistant variety has been carried out using extremely late maturing varieties in the warm region.

Consequently the degree of resistance of relatively early varieties in northern Japan to this disease has been unknown.

The Laboratory has clarified ecology in occurrence of the disease and research is being carried out on the examination of varietal resistance, investigation of parental materials for crossing and classification of fungi strains. It has been discovered that no variety grown in the District is strong to this disease.

However, the Ginbozu and Aikoku varieties are to some extent stronger than the Asahi varieties, planted acreage of which has been increased recently. Varieties such as Nakate-ginbozu, Koshihikari, Honen-wase, Ohute-ginbozu Yachikogane, Yomohikari, etc. are medium in resistance to this disease and can be used as parental materials for crossing.

Moreover, it has been found that the strains of pathogen which infect resistant varieties considerably are distributed even in this District.

3. Disease damage of forage crop.

It is very difficult to stabilize the production of forage crop growing under the unfavorable condition such as heavy rain and snow fall in Hokuriku District, because of crop's susceptibility to various diseases. In order to find out the kinds of diseases infecting forage crop, the distribution and degree of damage in field on-the-spot survey has been made. And the following diseases have been observed.

(1) Legumes: Sclerotinia rot, Pythium snow blight, Virus diseases for Renge (Astragalus sinicus L.) and other legumes.
Southern sclerotium blight for Ladino clover.
Rust, Rhizoctonia rot for Red clover.

(2) Grasses: Speckled snow mold, Rhizoctonia rot, and Rust for Perennial or Italian ryegrass.
Brown leaf streak and Scald for Orchardgrass.

Besides, the effect of seed disinfection and dusting by mercury compound (Ethyl mercury phosphate or methyle mercury iodide, content of Hg --- 0.5%) in late autumn on Renge Sclerotinia has been found.

2nd Laboratory of Plant Disease.

Research Subjects.

1. Ecology of rice plant disease and forecasting of outbreak.
2. Rice plant disease control by chemicals.
3. Labor saving disease control method.

Present Research Situation.

Disease control should be carried out precisely and economically. Recently new and very effective agricultural chemicals became available one after another. So the Laboratory is making the fundamental research on the properties and effectiveness etc. of new agricultural chemicals to use the same most effectively. Because the disease control should be carried out not only with agricultural chemicals but, with the farming method established with the result of an investigation of ecology, the Laboratory is conducting the detailed investigation and research on the relation of the change in crop season and fertilizer application to the disease outbreak.

The Laboratory is also making research on the life-cycle of rice blast fungi, the dispercing of the same spores and problems relevant thereto to find out forecasting method of disease outbreak as well as on the use of large sized control machinery, and the use of agricultural chemicals mixed with various components.

Main Results.

1. Ecological study of rice blast outbreak and control thereof.

Because the rice blast is the most important disease in Hokuriku causing serious damage, stress has been placed on research thereof. First, morphological study on the lesion of rice leaf blast was made by dividing the lesion into four types, clarifying each type. The results have been put in practical use in the field of testing of resistance to disease and of forecasting of disease outbreak.

Next, research was made on the ecology in occurrence of neck blast. Clarified how, when and where is the outbreak of neckblast, it was concluded that controlling conducted over a wide area in each other's cooperation is the most effective. Blade node blast does not by itself bring about serious damage on rice. However, because these

diseases supply their fungi to ear neck, node, etc., these blast diseases are of great significance and should not be overlooked from the standpoint of disease control.

2. Ecological study of sheath blight of rice plant.

Recently, sheath blight has been recognized as a disease which inflicts serious damage on rice plant. The Laboratory investigated the damage by this disease and found that the disease could be controlled by organic arsenicals.

The Laboratory has also found that the disease resembling to sheath blight on weed attacked rice plant and pointed out that the disease on weed is important as source of disease infection.

In addition, this laboratory clarified a fact that PCP being used for weed control has a property as chemicals for the control of sheath blight and this study became a starting point for this Laboratory to set about research on the labor saving disease control.

3. Study on rice stem rot.

Stem rot is a disease closely related to the lodging of rice plant. Among the researches in laboratory and on field are the relation between this disease and rice varieties, the relationship between the degree of its outbreak and irrigation and drainage. Practice of deep irrigation at the time when the fungi begin to invade rice plant and that of shallow irrigation after earing expedite the disease outbreak. The disease has a tendency of more outbreak on early varieties.

The name of stem rot is used identically to both diseases of stem rot and irregular stem rot. But, between properties of two diseases there is a considerable difference. That is, stem rot tends to occur in ill drained paddy field and on late maturing varieties and irregular stem rot in well drained paddy field and early maturing varieties with different outbreak degree by prefecture.

1st Laboratory of Soil and Fertilizer.

Research Subjects.

1. Survey and investigation of the soil types of ill drained paddy field in Hokuriku.

2. Research on paddy soil after the construction of drainage in ill drained paddy field.

3. Fundamental research on soil management after the construction of drainage in ill drained paddy field (Experiment with monolith lysimeter)

4. Change of soil in paddy field with heavy application of compost or green manures and its effect on rice growth.

Present Research Situation and Main Results.

1. About 60% of the total paddy field in Hokuriku District (220,000ha) is ill drained. So productivity increase thereof is a very important issue. Recently with drainage these ill drained paddy fields have gradually been improved. However, there occur several cases which the drainage of ill drained paddy field results in yield decrease, more than bringing about yield increase. As one of reasons, it may be pointed out that soil management, irrigation control and cultivation method fitted to the change in soil properties after draining were not practiced. To obtain the fundamental data for enhancing the effect of drainage and for establishing the rational soil management method, survey and investigation of the soil type in ill drained paddy field have been conducted. By the results obtained by today, ill drained paddy soil in Hokuriku has been classified into 21 types.

2. In a research on paddy soil after draining of ill drained paddy field, the change in physical and chemical properties of soil and its effect on rice growth and yield are being examined, comparing the plot under successively submerged condition with that under well drained condition by underdrainage.

The research was launched seven years ago. The yield in the plot under well drained condition was slightly higher than that in the plot under successively submerged condition for the first two years. But after three years the yield showed a tendency to decrease year by year. The soil in the plot is alluvial loam but it was clearly found that the drying effect

of paddy soil remarkably decreased in 5 or 6 years. The amount of ammoniacal nitrogen (NH_3-N) of the plot (not planted by rice-plant) under submerged condition was more than that under well drained condition throughout the whole period of rice growth.

3. In a fundamental research on soil management after draining of paddy field (large-sized lysimeter experiment), problems on how to manage locks of underdrainage and how to control irrigation water and their relations to kinds of soils are being examined. In last year, uniformity trial was made, namely, paddy rice was grown under normal same conditions on 16 experimental plots (1 plot area 2m x 2m). During that time, changes in soil temperature and in physical and chemical properties of soil, and percolation water were measured successively. Soils used for experimental plots are three main ill drained paddy soils in Hokuriku as follows with great difference in properties.

(1) Containing a layer of peat in soil profile.
(2) Containing heavy clay in gley horizon.
(3) Containing sand in gley horizon.

A new experiment is due to begin in this year, setting the following five treatments:

(1) Plot under submerged condition throughout whole season.
(2) Plot prevented leaching throughout whole season.
(3) Plot not prevented leaching throughout whole season.
(4) Plot prevented leaching excluding early growing stage.
(5) Plot prevented leaching excluding late growing stage.

4. With the expected introduction of livestock more forage crop will be cultured in paddy field. Consequently a large quantity of organic matter will be applied to as manure or left in paddy field. To obtain fundamental data on the influence of those organic matters upon soil and rice growth, the 4th experiment stated above is being conducted by using small sized lysimeter.

2nd Laboratory of Soil and Fertilizer.

Research Subjects.

1. Soil amelioration in upland field and improvement of fertilizer application.

2. Analysis of techniques for producing high rice yield from the pedological standpoint.

3. Deep plowing of paddy field and analysis of its effects from the pedological standpoint.

4. Application effects (including foliar application) of nitrogenous fertilizers and minor elements on rice cultivation.

Present Research Situation.

1. As to the soil amelioration of upland field and the improvement in the fertilizer application method, the Laboratory at present is dealing with the problem on special ingredients such as magnesium and other minor elements.

2. As to the analysis of techniques for producing high rice yield from the pedological standpoint, the Laboratory is conducting a comprehensive experiment which was designed by arranging various techniques obtained at this Station, simultaneously referring to instances tried at many other stations. The core of technique in this comprehensive experiment is that of water management.

3. An experiment for solving the problem on deep plowing in paddy field and analysis of its effect from the pedological standpoint was set about preliminarily in 1959 and is being conducted as formal one in 1962. Main purpose of this experiment is to find paddy soil suitable for deep plowing, to examine how long the effect of deep plowing continues and to establish the method of how to grow rice, especially the method of placement of fertilizer.

Main Results.

Main results having so far been published are as follows:

1. Research on the maintenance of soil fertility in paddy field in the nature.

2. Research concerning iron mottles and concretion of $FeCo_3$ existing in the soil profile of paddy field.

3. Research on molybdenum contained in rock phosphate, serpentine, fused phosphates and others.

4. Research on molybdenum as a minor element to crop.

Laboratory of Insect Pests.

Research Subjects.

L. Fluctuation of population density of serious insect pests in paddy field and forecasting of their outbreak.

2. Diagnosis of damages by insect pests in rice crop cultivation.

3. Establishment of effective and labor saving chemical control.

4. Screening of new agricultural chemicals for control of insect pests and practical application.

5. Ecology of insect pests affecting forage crop and their control.

Present Research Situation.

1. Ecology of rice stem borer and its control.

A. Analytical studies on variation of population density.

(1) Local variation of growth habit of rice stem borer in Hokuriku District.

(2) Influence of rice blast fungi on growth and development of rice stem borer.

(3) Relationship between snow-cover and selection of overwintering

B. Diagnosis of injurious feature of rice plant damaged by rice stem borer.

(1) Varietal differences in growth of rice stem borer by aseptic rearing method.

C. Special application method of insecticide in paddy field.

(1) Effects of insecticide applied into soil or irrigating water.

(2) Effects of mixing chemicals with insecticide and herbicide applied into irrigating water.

2. Ecology of rice stem maggot and its control.

A. Analytical studies on variation of population density.

(1) Growth habit of 2nd generation larvae in summer season.

(2) Phenomenon of mingled occurrence with two-and-three-generation individuals.

(3) Influence of environmental factors on variation of generation

3. Increasing population of green rice leafhopper and leaf hopper and injurious feature of rice plant.

(1) Increasing phase of population density in paddy field.

(2) Indoor mass production with young rice seedlings.

(3) Relationship between annual population caught by light trap

and meteorological factor.

(4) Yield reduction caused by smaller brown planthopper after heading.

4. Increasing phase of insect injuricus affecting young seedling of rice plant.

(1) Increasing phase of population density of apple grain aphid in seed bed.

5. Fundamental examination of new insecticides for practical application.

(1) Screening tests of new insecticides for judgement of lethal dosages.

(2) Field experiments regarding quantity and timing of application.

6. Ecology of injurious insects on forage crops and its control.

(1) Field observation on injurious feature by insect pests of forage crop.

(2) Damage caused by striped flea beetle on turnip for forage and its control by insecticide.

Main Results.

1. Injurious insects to rice.

As to rice stem maggot, study on the phase of yearly occurrence, mechanism of damage, difference in damages among rice varieties, ecology and physiology in overwintering, mechanism of how agricultural chemical kill maggot and others were studied and the results have contributed to forecasting and practical control.

As to rice rootworm, rice rootmaggot and smaller earthworm, their ecology, damage and control method were studied.

As to rice stem borer, the relationship between early seasonal rice culture and their damages was pursued. And besides, many new facts on the ecology and controlling of rice nematode have been clarified.

2. Insect pests on soybeans.

As to kinds of insect pests and their damages, ecological analysis was made concerning bean webworm soybean root miner, soybean stem miner, soybean flower midge and soybean nematode and some fundamental data for the control thereof have been established.

3. Insect pests on wheat and barley.

New facts have been found on ecology, insect parasites and others of aphids, barley stem maggot, rice crane fly and mole cricket.

4. Insect pests on Renge.

Fauna and population variation of insect pests including unknown species were clarified and their injurious features have been investigated.

5. Other species.

Ecology of many species affecting forage crop, vegetable, etc. and control thereof have been investigated.

Laboratory of Agricultural Climate.

Research Subjects.

1. Research on snow damage and its control.
2. Investigation of influence of climate on crop culture in Hokuriku.
3. Meteorological survey on agricultural water use in snowy districts.
4. Experiment concerning improvement of meteorological condition under which crop is grown.

Present Research Situation.

1. Research on the mechanism of snow damage to crop. (Investigation of micrometeorological conditions on soil surface under snow-cover) Snow damage observation facilities were established at the end of 1962. Prior to completion of these facilities, the following preliminary experiments were conducted:

(1) Measurement of light, aeration and others;

(2) Relationship of physiology of crop being grown under snow-cover and disease damages to such micrometeorological conditions.

2. Research on regional characteristics in techniques for promoting snow-thawing:

Promoting of snow-thawing greatly contributes to alleviation in snow damages. Effects of various snow-thawing methods vary with regional and yearly meteorological conditions. To comprehend the characteristics of techniques for snow-thawing most effective for the meteorological environment of this District various kinds of snow-thawing methods are being applied and their effects are being examined.

3. Investigation of meteorological characteristics in rice-growing season:

It is said that the meteorological conditions in Hokuriku District are unfavorable for rice growing, because of short daylight hours and high moisture. To make certain of those facts and to contribute to the improvement of rice culture statistical analysis on meteorological elements in this District is being conducted.

4. Investigation of raising of water temperature in reservoir.

The heat efficiency of facilities for warming irrigation water has been measured to obtain fundamental data necessary for improving the existing facilities and their operating method, and for designing new facilities.

5. Research on controlling of water and soil temperature in paddy field. (Research on raising of water temperature by "OED")

Use of "OED" for raising water and soil temperature on the surface of paddy field is to some extent put into practice. However, there remain problems concerning spreading method of "OED" and analysis of its effect. To clarify these problems, field experiments are being conducted.

6. Research on practicability of wilting control chemicals.

Rice growth at the early stage will be stabilized and quickened, provided that wilting and damages of rice seedlings when transplanting are prevented. As one of attempts, experiments to prevent evaporation from the surfaces of rice seedlings by "OED green" and an analysis of its effect have been conducted.

7. Meteorological study on airy dispersion of rice blast fungus spores.

Relationship between the density of airy dispersion of rice blast fungus spores and meteorological conditions of stratum touching the surface of ground has been pursued. Simultaneously an analysis by the theory of atmospheric dispersion has been done. Those researches will contribute to progress in techniques of disease outbreak forecasting.

Main Results.

1. Survey was made on the heavy snowfall from the end of the 1950's to the biginning of 1961 and of its damage.
2. Preliminary experiment to promote snow-thawing was finished.
3. Observation of phenomena above the surface of snow was done.
4. Mechanical damage of overwintering crops by snow and balance of heat in reservoir for raising irrigation water were investigated.
5. A relationship between degree of airy dispersion of rice blast spores and wind velocity was clarified in cooperation with the Plant Disease Laboratory and some fundamental data of disease outbreak forecasting have been obtained.

Table 1. Climatic Comparison of Various Places

Meteorological Station	Altitude (m)	Mean Annual Temperature	Temperature(C) May -October Total	May -October Average	Nov. -April Total	Nov. -April Average
Sapporo	18.1	7.4	95.2	15.9	-6.3	-1.1
Akita	9.9	10.5	110.9	18.5	15.2	2.5
Morioka	156.4	9.3	104.8	17.5	6.9	1.2
Takada	14.7	12.7	122.4	20.4	30.0	5.0
Toyama	9.6	13.0	123.5	20.5	32.7	5.5
Kanazawa	28.5	13.3	123.9	20.6	35.6	5.9
Fukui	11.0	13.6	127.3	21.2	35.7	5.9
Tokyo	5.8	14.3	128.5	21.4	43.6	7.3
Hamada	19.7	14.6	125.7	20.9	49.0	8.2
Hiroshima	30.4	14.6	130.6	21.8	44.8	7.5
Kagoshima	5.4	16.6	138.2	23.0	99.4	16.6

	Sunshine Hours (h) May-Oct.	Nov.-April	Total	Precipitation (mm) May-Oct.	Nov.-April	Total
Sapporo	1,127	747	1,873	569	494	1,061
Akita	1,144	547	1,690	989	808	1,797
Morioka	1,067	888	1,955	768	437	1,205
Takada	1,147	691	1,838	968	2,083	3,051
Toyama	1,156	679	1,835	1,050	1,251	2,299
Kanazawa	1,186	668	1,854	1,116	1,405	2,520
Fukui	1,177	686	1,862	1,024	1,366	2,389
Tokyo	1,043	1,053	2,094	1,049	515	1,564
Hamada	1,270	758	2,029	949	663	1,613
Hiroshima	1,284	1,026	2,311	1,028	497	1,523
Kagoshima	1,232	1,003	2,234	1,473	715	2,187

Table 2. Land Use in Hokuriku District, 1960

Item / Land Area	Hokuriku District(A)	Whole Country(B)	Ratio A/B
Total Land Area	25,251 km2	369,766 km2	6.83%
Agricultural Land Area	4,529	64,282	7.05
Cultivated Land Area	4,151 (100)	53,287(100)	7.79
Paddy Field	3,475 (83.7)	29,645(55.7)	11.72
Upland Field	593 (14.3)	20,346(38.2)	2.92
Land for growing tree, vines and shrubs	83 (2.0)	3,245(6.1)	2.56
Pasture Land & Meadow	50	4,045	1.25
Forest Land	34	2,338	1.44
Others	294	4,663	6.30
Cultivated Land Area / Total Land Area	16.4 %	14.4 %	---

Table 3. Area of Paddy Field, by Use, 1960

Item / District	Total	Fallow	Paddy field planted by rice		Paddy field planted by other crops
			Single-cropping paddy field	Double-cropping paddy field	
Hokuriku	ha	ha	ha	ha	ha
Area	347,485	333	307,510	37,206	2,436
Ratio	100 %	0.10 %	88.50 %	10.71 %	0.70 %
Whole Country	ha	ha	ha	ha	ha
Area	2,964,502	4,485	2,040,133	903,678	16,210
Ratio	100 %	0.15 %	68.82 %	30.48 %	0.55 %

Table 4. Total Area Planted, 1960

(ha)

Crop / District	Rice	Wheat, barley, naked barley, oats & rye	Sweet potatoes	White potatoes	Miscellaneous cereals	Pulses
Hokuriku	370,200	11,230	10,110	9,511	3,666	32,834
All Japan	3,336,000	1,533,000	332,600	205,920	170,990	692,560
Ratio	11.10	0.73	3.30	4.62	2.14	4.74

Crop / District	Vegetables	Fruits & nuts	Industrial crops	Crops for green manure & forage	Mulberry	Nursery *
Hokuriku	31,886	6,451	12,508	52,000	6,520	1,801
All Japan	506,960	252,700	430,667	519,500	167,548	11,530
Ratio	6.29	2.55	2.90	1.02	3.89	15.62

Crop / District	Total area planted (A)	Cultivated land (B)	B/A (%)	Planted area of winter crops **		
				Total	Paddy field	Upland field
Hokuriku	548,717	415,091	132.2	80,508	54,548	26,160
All Japan	8,150,975	5,323,668	153.1	2,285,850	1,053,340	1,232,510
Ratio	6.73	7.80	---	3.52		2.12

* Nursery are is total of those which are used for pulses, vegetables, green manuring crops and forage crops.

** In winter crops are included wheat, barley, naked barley, oats, rye, potatoes planted in early spring, peas, kidney beans, spinach, onion, rape, mat rush and renge.

Table 5. Number of Livestock in Hokuriku District, by Kinds

Item	Year	Niigata	Toyama	Ishikawa	Fukui	Hokuriku District	Whole Country
Milk cow	1950	3,367	1,264	1,779	880	7,290	203,825
	1955	6,840	2,320	3,020	1,240	13,420	421,110
	1960	11,125	3,808	3,909	2,226	21,068	749,310
Dual-purpose cattle	1950	67,308	8,749	21,611	11,131	108,798	2,254,913
	1955	86,950	13,400	20,880	13,520	134,750	2,636,490
	1960	72,196	8,710	14,528	11,567	107,001	2,282,785
Horse	1950	17,032	13,996	4,519	5,216	40,763	1,075,975
	1955	13,740	10,520	2,700	4,570	31,530	927,260
	1960	5,084	3,252	1,748	1,970	12,054	654,883
Hog	1950	17,456	8,852	6,738	3,375	36,421	623,277
	1955	31,930	8,390	7,660	1,200	49,180	825,160
	1960	59,177	11,097	7,439	1,690	79,403	715,152
Sheep	1950	7,930	844	504	860	10,138	364,427
	1955	24,660	2,940	2,680	2,590	32,870	784,020
	1960	25,529	4,442	2,221	2,429	34,621	715,162
Goat	1950	15,390	2,599	1,815	1,401	21,205	418,375
	1955	24,440	2,770	3,360	2,550	33,120	532,960
	1960	21,555	5,547	4,127	2,640	33,869	532,515
Hen	1950	480,475	185,145	154,319	129,492	949,431	16,633,703
	1955	989,000	464,000	295,000	247,000	1,995,000	45,715,000
	1960	896,587	484,827	369,883	292,008	2,043,305	46,844,706
Livestock production unit per 100 farm *	1950	38	29	29	22	32	52
	1955	53	36	32	27	42	69
	1960	49	29	28	26	38	66
Ditto, excluding horse	1950	32	16	25	17	26	39
	1955	48	26	30	22	37	57
	1960	47	26	27	23	36	58

* Livestock production unit per 100 farm household is calculated by the following rate.

Kind	Unit	Kind	Unit
1 Milk cow	1.00	1 Calf for beef-use	0.34
1 Beef cattle	0.75	1 Hog	0.27
1 Breeding cattle	0.74	1 Sheep or goat	0.15
1 Calf for milk-use	0.44	100 Hens	1.38

Table 6. Area of Degraded Soils in Hokuriku District, by Kind (ha)

(1) Paddy field

Prefecture	Total Area	Acidic soil area	%	Inferior volcanic ash soil area	%	Peaty soil area	%	Heavy clay soil area	%	Over-humus soil area	%
Niigata	174,061	7,872	4.5	7,856	4.5	9,958	5.7	1,320	0.7	3,108	1.8
Toyama	73,267	7,026	9.6	--	--	475	0.6	66	0.1	1,511	2.1
Ishikawa	50,168	3,514	7.0	--	--	83	0.2	797	1.6	--	--
Fukui	44,463	1,887	4.3	575	1.3	23	0.1	3,447	7.6	95	0.2

Prefecture	Iron-deficient soil area	%	Sandy soil or soil rich in gravel area	%	Elements deficient soil area	%	Soil containing harmful ingredient area	%
Niigata	4,965	2.9	2,030	1.2	--	--	--	--
Toyama	15,821	21.6	--	--	--	--	--	--
Ishikawa	5,794	11.5	328	0.7	40	0.1	--	--
Fukui	4,248	9.6	2,135	4.8	614	1.4	31	0.1

Prefecture	Total area	%
Niigata	37,109	21.3
Toyama	24,899	34.0
Ishikawa	10,556	21.0
Fukui	13,055	29.4

(2) Upland field

Prefecture	Total area	Acidic soil area	%	Inferior volcanic-ash soil area	%	Heavy clay soil area	%	Over-humus soil area	%
Niigata	45,080	21,590	48.0	7,800	17.3	110	0.2	--	--
Toyama	6,211	3,091	49.8	--	--	34	0.5	288	4.6
Ishikawa	11,245	3,801	33.8	--	--	200	1.8	--	--
Fukui	6,431	1,566	24.3	232	3.6	186	2.9	20	0.3

Prefecture	Sandy soil or soil rich in gravel area	%	Elements deficient soil area	%	Total area	%
Niigata	7,814	17.3	1,500	3.3	38,814	86.1
Toyama	--	--	--	--	3,413	54.9
Ishikawa	971	8.6	508	4.5	5,480	48.7
Fukui			--	--	2,233	34.7

Table 7. Number of Agricultural Machinery introduced per 100 ha in Hokuriku District, by kinds

Item	Year	Oil engine	Electric motor	Tiller	Power thresher	Power huller	Power sprayer	Power duster	Power cutter
Whole	1955	16.6	14.8	1.1	29.1	10.4	1.0	0.2	1.7
Country	1960	28.0	18.6	8.5	40.9	13.9	4.3	2.4	6.0
Hokuriku	1955	4.2	38.6	1.7	43.6	23.5	0.2	0.3	0.6
District	1960	7.4	51.7	14.9	56.6	32.6	2.3	4.8	3.0
Niigata	1955	5.8	42.7	1.8	46.6	26.6	0.2	0.2	1.1
	1960	9.2	52.6	16.7	58.3	35.4	2.7	6.2	4.9
Toyama	1955	4.0	37.2	2.8	48.4	24.4	0.3	0.4	0.3
	1960	7.1	54.0	16.2	60.1	33.0	1.5	4.4	2.4
Ishikawa	1955	2.7	30.6	1.1	32.9	16.9	0.3	0.4	0.1
	1960	5.3	43.8	12.0	47.1	25.1	2.7	2.7	0.5
Fukui	1955	1.8	38.2	0.6	41.8	21.7	0.2	0.4	0.2
	1960	4.6	55.6	11.0	58.7	33.0	1.4	3.7	0.8

		Power pump	Truck & auto-tricycle
Whole	1955	0.3	0.8
Country	1960	4.2	1.7
Hokuriku	1955	0.2	0.3
District	1960	1.2	1.4
Niigata	1955	0.2	0.3
	1960	1.7	1.8
Toyama	1855	0.3	0.4
	1960	0.6	0.6
Ishikawa	1955	0.3	0.5
	1960	0.9	1.7
Fukui	1955	0.3	0.2
	1960	0.6	0.5